CHITON (MOLLUSCA: POLYPLACOPHORA) FAUNA OF BARBADOS, WEST INDIES, WITH THE DESCRIPTION OF A NEW SPECIES

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ABSTRACT

Seventeen species of chitons, one new, have been found in Barbados, the easternmost island of the Lesser Antilles: *Lepidochitona beanii* (Carpenter, 1857), *Ischnochiton striolatus* (Gray, 1828), *I. erythronotus* (Adams, 1845), *I. pseudovirgatus* Kaas, 1972, *I. bromleyi* Ferreira, new species, *Stenoplax limaciformis* (Sowerby, 1832), *S. boogii* (Haddon, 1886), *Ischnoplax pectinata* (Sowerby, 1840), *Ceratozona squalida* (Adams, 1845), *Chiton tuberculatus* Linnaeus, 1758, *C. marmoratus* Gmelin, 1791, *C. viridis* Spengler, 1797, *Tonicia schrammi* (Shuttleworth, 1853), *Acanthopleura granulata* (Gmelin, 1791), *Acanthochitona astrigera* (Reeve, 1847), *A. rhodea* (Pilsbry, 1893), and *Choneplax* cf. *C. lata* (Guilding, 1829). One of these species, *I. bromleyi,* is endemic; four, *I. striolatus, S. limaciformis, S. boogii, I. pectinata,* range southward to Brazil; five, *L. beanii, S. limaciformis, S. boogii, C. squalida, A. rhodea,* occur in both Caribbean and tropical eastern Pacific. Some significant taxonomic changes are proposed: *Ischnoplax* is elevated to generic level; *Ischnochiton boogii* is allocated to *Stenoplax*; *Lepidochitona liozonis* and *L. rosea* are regarded as junior synonyms of *L. beanii*; *Acanthochitona hemphilli* is regarded as junior synonym of *A. rhodea*; *Acanthochitona elongata, A. interfissa* and *A. andersoni* are regarded as synonyms of *Choneplax lata.*

As the easternmost island of the Lesser Antilles, Barbados (13°04'N, 59°37'W) is exposed to the unimpeded impact of the North Equatorial Current, while its relative closeness to northern Brazil subjects it to the seasonal influence of the Amazon (Kidd and Sander, 1979). The surface waters are remarkably constant in temperature, 26–28°C, but vary in salinity from 33.40‰ in summer to 35.39‰ in winter. The lower salinity in the summer, accompanied by an increase in plankton biomass, has been shown to be directly related to the seasonal precipitation and run-off in the Amazon region (Kidd and Sander, 1979). For all of these reasons, the marine fauna of Barbados, part of the Caribbean zoogeographic province (Briggs, 1974), is of particular interest.

Dr. Richard G. Bromley, Institute of Historical Geology and Paleontology, University of Copenhagen, and Dr. Jorgen Knudsen, Zoological Museum of the University of Copenhagen, while at the Bellairs Research Institute of McGill University, Barbados, in May–April, 1980, and 1976, respectively, collected 38 lots of chitons, comprising 92 specimens, which were entrusted to me for study. The material has been supplemented since with specimens and observations accumulated by the author during a working visit to the Bellairs Research Institute in Barbados, July 1982, and with the generous assistance of Tina Ortiz, marine geologist in residence at the Institute. In addition, a study was made of specimens from the California Academy of Sciences (CAS), Los Angeles County Museum of Natural History (LACM), United States Museum of Natural History (USNM), Museum of Comparative Zoology, Harvard University, Cambridge (MCZ), Indian River Coastal Zone Museum, Fort Pierce, Florida (IRCZM), Mikkelsen Malacological Collection, Fort Pierce, Florida (MMC), Muséum National d'Histoire Naturelle, Paris (MNHN), Rijksmuseum van Natuurlijke Historie, Leiden (RMNH), Zoological Museum of the University of Copenhagen (ZMUC), Department of Zoology of the Universidade de São Paulo, Brazil (ZU), Museu

Oceanográfico da FURG, Rio Grande, Brazil (MORG), and in the private collection of A. J. Ferreira (AJF collecting station numbers on file at CAS).

The chiton fauna of Barbados is particularly rich. Seventeen species are here recognized, one new to science: *Lepidochitona beanii* (Carpenter, 1857); *Ischnochiton striolatus* (Gray, 1828); *Ischnochiton erythronotus* (Adams, 1845); *Ischnochiton pseudovirgatus* Kaas, 1972; *Ischnochiton bromleyi* new species; *Stenoplax limaciformis* (Sowerby, 1832); *Stenoplax boogii* (Haddon, 1886); *Ischnoplax pectinata* (Sowerby, 1840); *Ceratozona squalida* (Adams, 1845); *Chiton tuberculatus* Linnaeus, 1758; *Chiton marmoratus* Gmelin, 1791; *Chiton viridis* Spengler, 1797; *Tonicia schrammi* (Shuttleworth, 1853); *Acanthopleura granulata* (Gmelin, 1791); *Acanthochitona astrigera* (Reeve, 1847); *Acanthochitona rhodea* (Pilsbry, 1893); and *Choneplax* cf. *C. lata* (Guilding, 1829).

The classification scheme suggested by Smith (1960), with minor modifications, is adopted here. Synonymies are limited to first references to species-names and to proposed genus-species combinations.

Systematic Treatment

Class Polyplacophora Gray, 1821
Order Neoloricata Bergenhayn, 1955
Suborder Ischnochitonina Bergenhayn, 1930
Family Lepidochitonidae Iredale, 1914

Lepidochitona Gray, 1821

Type Species.—*Chiton marginatus* Pennant, 1777 [=*Chiton cinereus* Linnaeus, 1767] by monotypy.

Lepidochitona beanii (Carpenter, 1857b)
Figure 1

Lepidopleurus beanii Carpenter, 1857a (nomen nudum); 1857b: 197.
Lepidochitona beanii (Carpenter). Ferreira, 1982: 102–104, figs. 12–17.
Chiton bipunctatus Sowerby (1st) *in* Broderip and Sowerby, 1832: 104.
Chiton flavescens Carpenter, 1857b: 198.
Ischnochiton (*Trachydermon*) *liozonis* Dall and Simpson, 1901: 452.
Tonicella (*Mopaliella*) *stigmata* Dall, 1909: 244 (new name for *C. bipunctatus* Sowerby, 1832, not Fischer, 1807).
Basiliochiton (*Lophochiton*) *lobium* Berry, 1925a: 27–28; pl. 2, figs. 1–2.
Lepidochitona tropica Pilsbry, 1940, pl. 12, fig. 4 (nomen nudum).
Trachydermon parvulus Leloup, 1941a: 42, figs. 8–9; pl. 1, fig. 3.
Lepidochitona liozonis tropica Kaas, 1972: 25–27, figs. 25–33; pl. 1, fig. 1.
Lepidochitona (*Lepidochitona*) *rosea* Kaas, 1972: 27–28, figs. 41–49.

Material from Barbados.—Bellairs Reef, off Holetown, at 16–30 m, 9 specimens, max. 6.4 mm long (AJF colln., *leg.* F. G. Bromley); Drummer Hole, off Holetown, at 17–21 m, 6 specimens, max. 5.5 mm long (AJF colln., *leg.* Tina Ortiz).

Distribution.—*Lepidochitona beanii* (Fig. 1) is present in both Caribbean and temperate to tropical eastern Pacific. In the Caribbean, it has been reported under different names from Barbados (Thiele, 1910b), Puerto Rico (Dall and Simpson, 1901), Colombia (Leloup, 1941a), Bonefish Key, Florida, St. Kitts and Trinidad (Kaas, 1972); in addition it is here recognized in Bermuda, Bahamas, Jamaica, and Venezuela. Thus, in the Caribbean it ranges from Bermuda (32°20'N) (AJF 333–340) to Trinidad (11°N), and from the Florida Keys (81°W) to Barbados (59°37'W). Bathymetric range, 0 to 16–30 m (Barbados: AJF colln., *leg.* R. G. Bromley).

In the eastern Pacific, *L. beanii* ranges from the Gulf of Santa Catalina, Cali-

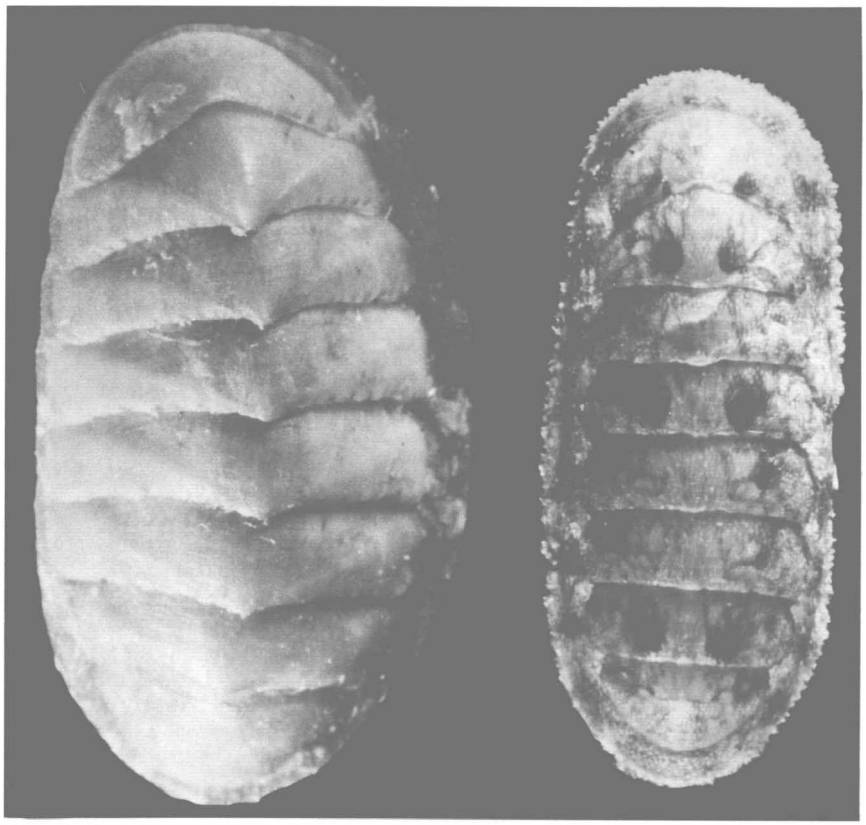

Figure 1. (Left) *Lepidochitona beanii* (Carpenter, 1857). Bellairs Reef, Holetown, Barbados; specimen 6.4 mm long. Figure 2. (Right) *Ischnochiton pseudovirgatus* Kaas, 1972. Bellairs Reef, Holetown, Barbados; specimen 5.7 mm long.

fornia (33°27′N) to Isla Lobos de Afuera, Peru (6°57′S), from 0 to 165–230 m (Ferreira, 1982).

Remarks.—Comparison of Caribbean specimens of *Lepidochitona liozonis* with eastern Pacific specimens of *L. beanii* revealed no particular differences in size, color, shape, tegmental surface, articulamentum, gills, girdle elements, or radula to justify segregation at the species level.

Eastern Pacific specimens of *L. beanii* are known to vary considerably in height, carination, degree of elevation of the lateral areas, and in the abundance of girdle spicules (Ferreira, 1982). Similar qualitative and quantitative variations have been observed in Caribbean specimens. In the Caribbean, it seems that specimens of *L. beanii* attain greater size in southern (warmer) waters than in the northern (colder) Bermuda water, becoming wider-bodied, less carinated, with less elevated lateral areas, and fewer girdle spicules.

From the descriptions and illustrations, *Lepidochitona parvulus* Leloup, 1941a, based upon three specimens 2 mm long, and *L. rosea* Kaas, 1972, based upon two specimens less than 7 mm long, differ in no essential respect from other Caribbean or eastern Pacific specimens of *L. beanii*.

Family ISCHNOCHITONIDAE Dall, 1889a

Ischnochiton Gray, 1847b

Type Species.—*Chiton textilis* Gray, 1828, by subsequent designation (Gray, 1847c).

Ischnochiton striolatus (Gray, 1828)

Chiton striolatus Gray, 1828: 6.
Ischnochiton striolatus (Gray). Pilsbry, 1892: 105, pl. 20, figs. 20–24.
Chiton squamulosus Adams, 1845: 8.
Chiton papillosus Adams, 1845: 9.
Chiton pruinosus Gould, 1846: 144; 1852: 316; pl. 27, fig. 419a–b.
Chiton (Ischnochiton) lutulatus Shuttleworth, 1853: 200.
Chiton (Ischnochiton) caribbaeorum Smith, 1890: 496; pl. 30, figs. 5, 5a.
Ischnochiton jamaicensis Carpenter *in* Pilsbry, 1892b: 108.
Ischnochiton viridior Carpenter *in* Pilsbry, 1892b: 108.
Ischnochiton pseudostriolatus Leloup, 1961: 6, text figs. 5, 6; pl. 1, fig. 3; pl. 2, fig. 3.

Material from Barbados.—Paradise Beach, St. Michael, 4 specimens (AJF 679); River Bay, 41 specimens, max. 21.6 mm long (AJF 680); Six Men's Bay, 46 specimens, max. 13 mm long (AJF 682); Six Men's Bay, 10 specimens, max. 16 mm long (AJF colln., *leg.* R. G. Bromley); Maycock's Bay, 12 specimens, max. 14.5 mm long (AJF 684); "west coast," at 16 m, 5 specimens, max. 11 mm long (AJF colln., *leg.* G. R. Bromley); Holetown, 3 specimens, max. 15 mm long (ZMUC); Nursery's Jetty, at 17 m, 1 specimen, 7 mm long (ZMUC); Graves End, 5 specimens, max. 15 mm long (ZMUC); Drummer Hole, off Holetown, at 17–21 m, 2 specimens (AJF colln., *leg.* Tina Ortiz); Bellairs Fringing Reef, at 3–5 m, 5 specimens, max. ca. 12 mm long (AJF colln., *leg.* Tina Ortiz); Fryer's Well Fringing Reef, at 10 m, 5 specimens, max. 10 mm long (AJF colln., *leg.* Tina Ortiz).

Distribution.—*Ischnochiton striolatus* has been reported from Texas (Andrews, 1971, as *I. papillosus*), Tampa, Florida and Florida Keys (Dall, 1889a), Jamaica (Adams, 1845; Kaas, 1972), Cuba (Leloup, 1938; Aguayo and Jaume, 1947, as *I. papillosus*), St. John, St. Croix, Antigua, Guadeloupe, Dominica, Martinique, Grenada, Tobago, Bonaire, Klein Bonaire, Aruba (Kaas, 1972), Curaçao (Nierstrasz, 1927; Kaas, 1972), Colombia (Leloup, 1938; Götting, 1973), Trinidad (Baboolal et al., 1981), and Brazil (Righi, 1967; Kaas, 1972); in addition, it is here recognized in North Carolina, Bahamas, Dominican Republic, Cayman Islands, Honduras, Venezuela, and Panama. Hence, it ranges from Bogue Inlet, North Carolina (34°40'N) (LACM 15588) to Armação, Santa Catarina Is., SC, Brazil (27°40'S) (MORG 17091), and from Aransas Pass, Texas, Gulf of Mexico (97°10'W) (CAS 012668; CAS 012671) to Fernando de Noronha, Brazil (32°25'W) (AJF 553; AJF 554; MORG 18661).

Bathymetric range, 0–16 m (AJF colln., *leg.* F. G. Bromley, W coast of Barbados). The undocumented record from off Fernandina, Florida, at 294 fathoms [535 m] (Johnson, 1934) is not credible.

Remarks.—Ferreira (1978) synonymized *Ischnochiton striolatus* (Gray, 1828), *I. papillosus* (Adams, 1845), and *I. erythronotus* (Adams, 1845), interpreting differences in tegmental sculpture as intraspecific variation. However, examination of additional *striatus*-like material has demonstrated that two species, *I. striolatus* and *I. erythronotus,* are present in the group, and found to differ in: (1) General shape (narrow, parallel-sided in *erythronotus*; wider, oval in *striolatus*). Comparing specimens collected at the same site, body width/length of *striolatus,* mean = 0.56 (SD = 0.043; N = 20); of *erythronotus,* mean = 0.49 (SD = 0.035; N = 20) (Student's $t = 5.60$; $P < 0.001$). (2) End valves and lateral areas (with radial riblets in *erythronotus*; without in *striolatus*). (3) Pleural areas (with parallel, longitudinal riblets in *erythronotus*; without in *striolatus*). (4) Jugal area (smooth, almost shiny, not pitted in *erythronotus*; quincunctially pitted in *striolatus*).

In addition, it seems that specimens of *striolatus* grow to larger sizes than specimens of *erythronotus*. At River Bay, Barbados (AJF 680), mean length of larger specimens of *striolatus*, 16.8 mm (SD = 3.1; N = 10); of *erythronotus*, 13.5 mm (SD = 1.6; N = 10). At Garden Key, Dry Tortugas, Florida (AJF 234), mean length of larger specimens of *striolatus*, 12.1 mm (SD = 1.5; N = 10); of *erythronotus*, 11.3 mm (SD = 2.2; N = 10) (for both samples, $P < 0.01$).

From this re-evaluation of the problem, *Chiton papillosus* (Adams, 1845) emerged as a junior synonym of *I. striolatus*. The lectotype of *I. papillosus* (MCZ 186100) has all the characteristics of *I. striolatus*, except for the absence of the concentric zigzagged sculpture on end valves and lateral areas (Ferreira, 1978); again, it was concluded that the lack of zigzag sculpturing, an extremely variable feature in *I. striolatus*, was not per se sufficient to justify segregation of specimens at species level. Specimens of "*papillosus*" have been listed in Jamaica (Adams, 1845, type locality), Texas (Andrews, 1971), west coast of Florida (Dall, 1889a; Smith, 1937; Perry and Schwengel, 1955), Florida Keys (Dall, 1889a; Pilsbry, 1892b; Kaas, 1972), Cuba (Aguayo and Jaume, 1947); Puerto Rico (Dall and Simpson, 1901; Warmke and Abbott, 1961), St. Thomas (Dall, 1889a), and Guadeloupe (Kaas, 1972). It is curious to note that all specimens of *I. striolatus* from the Gulf of Mexico exhibit the "*papillosus*" form.

The report of *Ischnochiton papillosus* in Pliocene deposits (Waccamaw formation) at Acme, Columbus County, North Carolina (Berry, 1940: 216, pl. 12 [erroneously cited as pl. 10], figs. 5, 6) is incorrect; the figured specimen shows a tegmental sculpture clearly different from that seen on the lectotype of *Chiton papillosus* Adams, 1845 (Ferreira, 1978, figs. 3–4).

The type material of *Chiton pruinosus* Gould, 1846 (type locality: "Rio de Janeiro") consists of two syntypes (USNM 5810), dry, slightly curled, 17 mm and 13.5 mm in length; larger specimen with one, smaller specimen with two blobs of red material (? glue) on jugum; girdle scales, very few remaining on specimen, oval, up to 200 m long, about 12 striations; tegmental features obliterated, in larger specimen by encrustations, in smaller (? worn) specimen by strong growth rugae. The specimens' general shape, size, girdle scales, mucro, and locality, permit an educated guess of conspecificity with *I. striolatus*, as noted by Carpenter (*in* Pilsbry, 1892b: 110).

Lepidopleurus corrosus Rochebrune, 1884 (type locality: Cochino Is., Guadeloupe) was regarded as possible synonym of *I. striolatus* by Kaas and Van Belle (1980). However, since its type material has not been found (Dr. P. Bouchet, MHNH, Paris, in litt. 16 Feb. 1983), and Rochebrune's (1884: 36) description of the species could as well apply to a number of other chitons in the area, it seems appropriate to discard the name *corrosus* as a nomen dubium.

Ischnochiton erythronotus (Adams, 1845)

Chiton erythronotus Adams, 1845: 9.
Ischnochiton erythronotus (Adams). Pilsbry, 1892: 104–105.
Chiton (*Ischnochiton*) *lateritius* Shuttleworth, 1853: 199.
Ischnochiton funiculatus Carpenter *in* Pilsbry, 1892b: 108–109.
"*Ischnochiton purpurascens* (Adams)" *ex auctore* after Pilsbry, 1892a: 58–59, pl. 17, figs. 23–24 [not *Chiton purpurascens* Adams, 1845 (=*Stenoplax limaciformis* (Sowerby, 1832))].

Material from Barbados.—River Bay, 14 specimens, max. 15.5 mm (AJF 680).

Distribution.—*Ischnochiton erythronotus* has been reported from Jamaica (Adams, 1845), Bonefish Key and Garden Key, Florida, Puerto Rico, St. Thomas, St. Eustatius, Guadeloupe (Kaas, 1972); it is here recognized in Barbados, Dominican

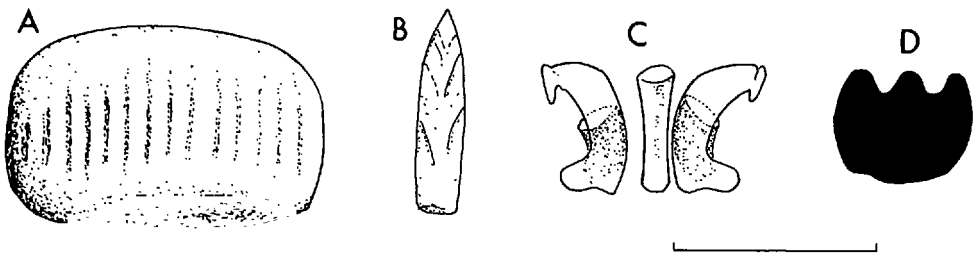

Figure 3. *Ischnochiton pseudovirgatus* Kaas, 1972. Bellairs Reef, Holetown, Barbados; specimen 4.2 mm long. A. Scale of upper surface of girdle. B. Marginal spicule of girdle. C. Median and first lateral teeth of radula. D. Head of major lateral tooth of radula.

Republic, Virgin Islands, Jamaica, Cayman Islands, Cozumel, Mexico, Belize, and Honduras. The report of the species in Bermuda (Goode *in* Pilsbry, 1893d: 75) was not corroborated in field work (A. J. Ferreira and W. E. Daily collecting trip to Bermuda, May 1977) or museum material (Bermuda Aquarium, Natural History Museum and Zoo, David D. Lonsdale, Curator: chiton collection on loan, September 1979). Thus, *I. erythronotus* ranges from Pepper State Park, Florida (27°29.6'N) (IRCZM 61:055) to Portobelo, Panama (9°33'N) (AJF 213; LACM 70-19), and from Garden Key, Dry Tortugas, Florida (82°53'W) (AJF 234) to Barbados (59°37'W) (AJF 680).

Bathymetric range, 0 to 10 m.

Remarks.—The holotype of *Chiton erythronotus* Adams, 1845 (MCZ 155960) was previously described (Ferreira, 1978a: 83–85, figs. 5–6).

Ischnochiton funiculatus Carpenter *in* Pilsbry, 1892b, was later (Pilsbry, 1892b) regarded as a synonym of *I. striolatus*. Kaas (1972: 86–87), upon examination of the type specimens, identified it as a synonym of *I. erythronotus*, instead.

Ischnochiton pseudovirgatus Kaas, 1972
Figures 2 and 3

Ischnochiton pseudovirgatus Kaas, 1972: 89–90, figs. 179–185.

Material from Barbados.—Six Men's Bay, at 30 m, 1 specimen, 4.5 mm long (AJF colln., *leg.* R. G. Bromley); Bellairs Reef, Holetown, at 25 m, 3 specimens, 4.1 mm, 4.3 mm and 5.2 mm (AJF colln., *leg.* R. G. Bromley); Bellairs Reef, Holetown, at 21 m, 3 specimens, 4.0, 5.7 (Fig. 2) and 6.0 mm long (AJF 681, *leg.* Tina Ortiz, Heather Kay and A. J. Ferreira); off Holetown, at 15 m, 1 specimen, ca. 3 mm long (ZMUC, *leg.* L. Haumann and J. A. Christiensen); Drummer Hole, off Holetown, at 21 m, 4 specimens, in rubble of *Acropora cervicornis*, max. 4.5 mm (AJF colln., *leg.* Tina Ortiz).

Description.—Largest specimen, 6.0 mm long (AJF 681: Bellairs Reef, Barbados); body width/length ratio, 0.5; cream speckled with brown, with minute blue dots against dark brown background on valve vii; one specimen with reddish brown jugal stripe and no blue dots; specimen from Six Men's Bay, white with elongated blue spots on pleural areas of valves ii, iv, and vii; slit formula, 5/9–1–7/8. Girdle's upper surface with imbricating scales up to 125 μm long, 45 μm wide [Kaas, 1972, states the scales being "96 μm wide, 32–38 μm long," a discrepancy due to either typographical error, or his calling length of a scale to what is here called width, and vice versa], with 12–18 striations (Fig. 3A); marginal spicules, 50 × 12 μm, with screw-like striations (Fig. 3B); undersurface with rectangular, transparent scales, 40 × 10 μm. Radula (of specimen 4.2 mm long) 1.6 mm long (38% of specimen's length), comprising 35 rows of mature teeth; median tooth (Fig. 3C)

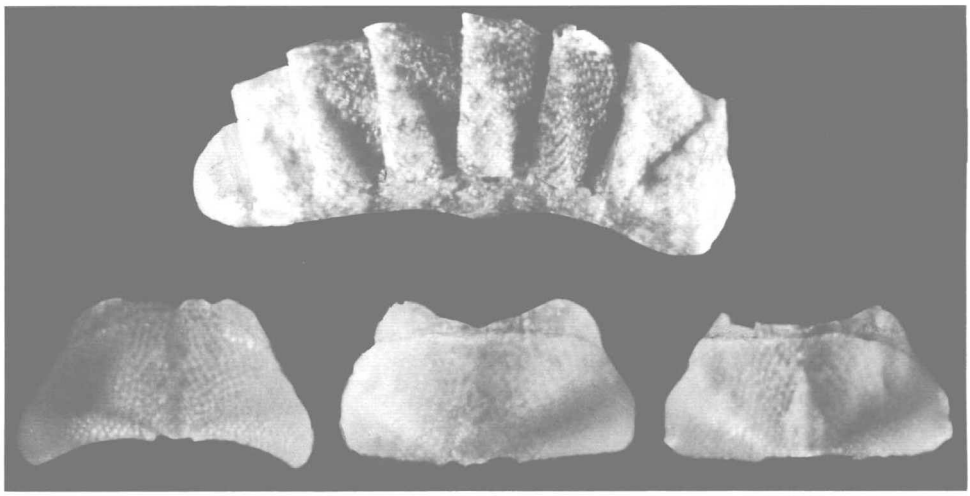

Figure 4. (Upper) *Ischnochiton bromleyi* new species. Holotype. Figure 5. (Lower Left) *Ischnochiton bromleyi* new species. Paratype, valve ii. Figure 6. (Lower Center) *Ischnochiton bromleyi* new species. Paratype, valve iv. Figure 7. (Lower Right) *Ischnochiton bromleyi* new species. Paratype, valve vi.

elongate, 30 μm long, 10 μm wide at anterior blade; first lateral teeth, 30 μm long, deeply embayed at outer edge, convex at inner edge, with roundish knob at anterior-outer corner; major lateral teeth with tricuspid head (Fig. 3D), 35 μm wide; outer marginal teeth, squarish, 40 × 40 μm.

Distribution.—*Ischnochiton pseudovirgatus* was described from Curacao, and Trinidad; it is here recognized off St. Lucie Inlet (IRCZM 61:019; IRCZM 61: 021), off Jupiter Inlet, Florida (IRCZM 61:020), and at Barbados.

Bathymetric range, 2–41.5 m.

Remarks.—Kaas (1972: 91) noted that *I. pseudovirgatus* "resembles" *I. hartmeyeri* Thiele, 1910b (which he had not seen at the time), in several respects. Based upon ample material of both species, this study showed that *I. pseudovirgatus* differs appreciably from *I. hartmeyeri* in its (1) more elongated shape, (2) smaller size, (3) coloration, (4) vestigial (rather than well defined) furrowing of lateral areas and end valves, (5) smaller sinus, (6) longer and differently shaped girdle scales, and (7) tricuspid (not unicuspid) radula.

Ischnochiton bromleyi new species
Figures 4–8

Type Material and Locality.—Holotype (CAS 043883) and 1 paratype (CAS 043884); Six Men's Bay, Barbados (13°15'N, 59°39'W), at 30 m (*leg.* R. G. Bromley, April–May 1980).

Diagnosis.—Very small chitons, strongly carinate, valves slightly beaked. Lateral areas elevated. Tegmental sculpture of microgranules in quincunx on end valves and lateral areas, aligned in forward converging rows on central areas. Mucro anterior; postmucro strongly concave. Girdle with small, striated, imbricated scales. Radula with tricuspid major lateral teeth.

Description.—Holotype (Fig. 4)—preserved in alcohol, relatively flat, 4.3 mm long, 2.2 mm wide (including girdle), cream mottled with light brown. Strongly carinate, valves slightly beaked. Lateral areas well defined, markedly elevated, sculptured

with minute, round granules, in quincunx; valve i and postmucro area valve viii similarly sculptured. Central areas with slightly larger, round granules, in forward converging rows. Mucro anterior, somewhat pointed; postmucro depressed, markedly concave. Girdle's upper surface banded brown-cream, with imbricating, striated scales. Gills, unascertainable.

Paratype (Figs. 5–7)—uniformly orange, about 3.5 mm long (if flattened), shape and tegmental characteristics as in holotype. Disarticulated valves extremely thin. Sutural laminae semioval continuing continuous across shallow sinus through well developed sinusal plate [callochitonid-like feature]. Slits 7–1–5. Valve i lost during study.

Girdle's upper surface with imbricated, oval, 70–80 μm long scales, with 10–14 striae defining that many flat ribs (Fig. 8A); bridges, empty; undersurface with rectangular, 40 × 10 μm, transparent scales (Fig. 8B). Radula, 1.1 mm long (33% of specimen's length) comprising 35 rows of mature teeth; median tooth elongate, 8 μm wide at anterior blade; first lateral teeth subrectangular, outer edge deeply embayed (Fig. 8C); second lateral teeth with tricuspid head, 20 μm wide, middle cusp largest (Fig. 8D); outer-marginal teeth squarish, 25 × 25 μm.

Distribution.—*Ischnochiton bromleyi* is known only from the type material, Six Men's Bay, Barbados, at 30 m.

Remarks.—The allocation of *bromleyi* to *Ischnochiton* is in part a question of *faute de mieux*. *Ischnochiton* has remained a poorly defined genus, somewhat of a "catch-all" group, plagued even by questions about the appropriateness of its type species (Ashby, 1931; Smith *in* Kaas, 1974b; Van Belle, 1974; Kaas, 1979). In the case of *I. bromleyi,* the presence of a callochitonid-like sinusal plate in an otherwise ischnochitonid body-plan is so far unique. Although the incongruity might suggest segregation at the generic level, it seems that no significant benefit would accrue from coining one more genus-name on such evidence.

The species is here named *bromleyi* after Dr. Richard G. Bromley, Institute of Historical Geology and Paleontology, University of Copenhagen, Denmark, who collected the specimens.

Stenoplax Dall, 1879

Type Species.—*Chiton limaciformis* Sowerby, 1832, by original designation.

Stenoplax limaciformis (Sowerby, 1832)

Chiton limaciformis Sowerby *in* Broderip and Sowerby, 1832: 26.
Ischnochiton (*Stenoplax*) *limaciformis* (Sowerby). Pilsbry, 1892: 57–58, pl. 16, figs. 9–16.
Chiton purpurascens Adams, 1845: 9.
Chiton productus Reeve, 1847, pl. 17, sp. 97.
Chiton sanguineus Reeve, 1847, pl. 17, sp. 98.
Onitochiton [sic] *pruinosum* Rochebrune, 1884: 35 [not *Chiton pruinosus* Gould, 1856].
"*Ischnochiton multicostatus* C. B. Adams," Dall, 1883: 337 [not C. B. Adams, 1845].
Ischnochiton (*Stenoplax*) *floridanus* Pilsbry, 1892a: 58, pl. 17, figs. 19–22.
Chiton angustus Clessin, 1904: 120, pl. 41, fig. 1.

Material from Barbados.—River Bay, 4 specimens, max. 18 mm (AJF 680); Six Men's Bay, 4 specimens (AJF 682; AJF colln., *leg.* R. G. Bromley); Maycock's Bay, 2 specimens, max. 14 mm (AJF 684); Holetown, 1 specimen, 30 mm long (ZMUC).

Distribution.—*Stenoplax limaciformis* is present in both Caribbean and tropical eastern Pacific. In the Caribbean it has been reported from Barbados (Thiele, 1910b; Kaas, 1972), Gulf of Mexico (Dall, 1889b), Florida Keys (Dall, 1889a; 1889b; Pilsbry, 1892a), St. John, St. Martin, Antigua, Grenada, Tobago, Aruba

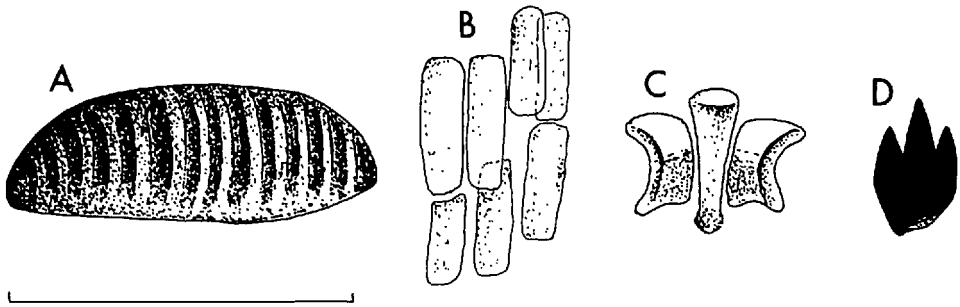

Figure 8. *Ischnochiton bromleyi* new species. Paratype: A. Scale of upper surface of girdle. B. Scales of undersurface of girdle. C. Median and lateral teeth of radula. D. Head of major lateral tooth of radula. Scale 100 μm.

(Kaas, 1972), Jamaica (Adams, 1845), Puerto Rico (Shuttleworth, 1853; Dall and Simpson, 1901), St. Vincent (Reeve, 1847), Panama (Olsson and McGinty, 1958), Colombia (Götting), Trinidad (Baboolal et al., 1981) and Brazil (Righi, 1971); in addition, it is here recognized in Grand Turk Is., Cuba, Dominican Republic, Cayman Islands, Guadeloupe, Cozumel, Tobago, Belize, Honduras, Panama, and Venezuela. Thus, *S. limaciformis* ranges from Bimini Islands, Bahamas (25°42'N) (AJF 289) to Alagoas, Brazil (10°35'S) (ZU 23), and from southeast Gulf of Mexico (83°26'W) (Dall, 1889b) to Barbados (59°37'W).

In eastern Pacific, *S. limaciformis* ranges from Tiburon Is., Gulf of California, Mexico (29°00'N) (CAS-SU 42717) to Punta Ancon, Ecuador (2°20'S) (LACM 70-11; LACM 70-12). Report of the species farther north in the Gulf of California at Puertecitos, and farther south in Peru (Thorpe *in* Keen, 1971) has not been corroborated.

Bathymetric range, in western Atlantic, 0–90 m (ZU 22: Righi, 1971); in eastern Pacific, 0–35 m (AJF colln.: Guaymas, Mexico).

Remarks.—*Stenoplax kempfi* (Righi, 1971), described from Itamaracá Is., Pernambuco, Brazil, at 0–1 m, is very similar to *S. limaciformis.* Examination of holotype (ZU 03) and two paratypic intermediate valves (ZU 04; ZU 05) disclosed no distinguishing features, except for large size of specimens (holotype, 87 mm long, about twice as large as largest *S. limaciformis* reported or examined); notwithstanding enormous size and intertidal habitat, known material remains limited to type specimens. The possibility that *S. kempfi* may be a gigantic form of *S. limaciformis* cannot be ruled out.

Type material of *Onitochiton* [sic] *pruinosum* Rochebrune, 1884, comprises two specimens (at MNHN) measuring (including girdle) 27.0 × 9.8 mm and 27.5 × 10.0 mm, accompanied by an old hand-written label stating "Type/Onitochiton pruinosum Rochbr./Ile Cochino, Guadeloupe," and a recent museum label recognizing them as "Syntypes." They correspond to Rochebrune's (1884) description of *O. pruinosum,* and, as anticipated by Kaas (1972) and Kaas and Van Belle (1980), the current concept of *S. limaciformis.*

The type material of *Chiton purpurascens* Adams, 1845, was reported elsewhere (Ferreira, 1978: 87–89, figs. 13–14).

Stenoplax boogii (Haddon, 1886), new comb.
Figure 9

Ischnochiton boogii Haddon, 1886: 15–16.
Chiton roseus Sowerby *in* Broderip and Sowerby, 1832: 58 [not Blainville, 1825].

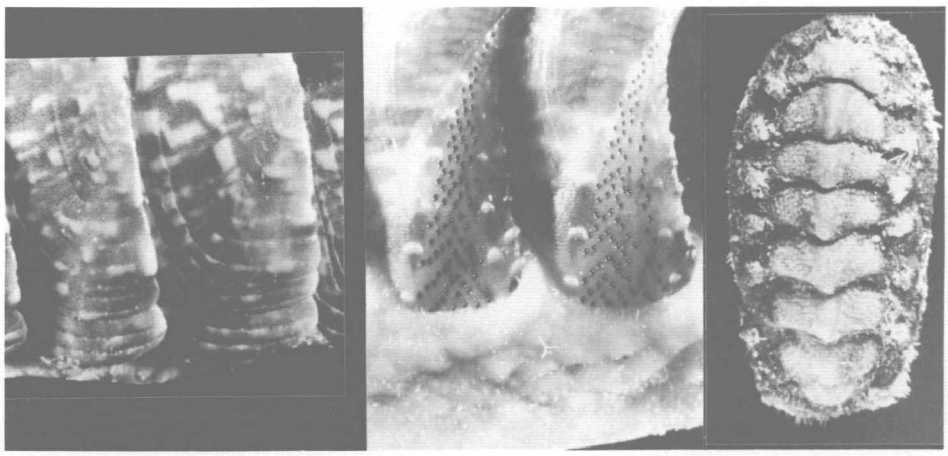

Figure 9. (Left) *Stenoplax boogii* (Haddon, 1886). Bellairs Reef, Holetown, Barbados; specimen 12.1 mm long. Close-up of lateral areas. Figure 10. (Center) *Tonicia schrammi* (Shuttleworth, 1853). Bellairs Reef, Holetown, Barbados; specimen 23 mm long. Close-up of lateral areas. Figure 11. (Right) *Acanthochitona astrigera* (Reeve, 1847). Nursery's Jetty, Barbados; specimen 4.7 mm long.

Ischnochiton bermudensis Dall and Bartsch, 1911: 287.
Ischnochiton (*Stenoplax*) *aethonus* Dall, 1919: 507–508.
Stenoplax isoglypta Berry, 1956: 72–73.
"*Radsiella rugulata* (Sowerby, 1832)," Thorpe *in* Keen, 1971: 869, sp. and fig. 20. [not *Chiton rugulatus* Sowerby, 1832].

Material from Barbados.—Bellairs Reef, Holetown, at 12–25 m, 3 specimens, max. 12.1 mm long (Fig. 9) (AJF colln., *leg.* R. G. Bromley); Nursery's Jetty, at 17 m, 1 specimen, 10 mm long (ZMUC).

Distribution.—*Stenoplax boogii* is present in the Caribbean and tropical eastern Pacific. In the Caribbean it has been reported from Bermuda (Dall and Bartsch, 1911; Peile, 1926; Kaas, 1972), Los Testigos (Leloup, 1938), Fernando de Noronha (Haddon, 1886) and Ceará to Alagoas, Brazil (Righi, 1971); in addition, it is here recognized in Florida, Bahamas, Cayman Islands, Virgin Islands, Belize, Aruba, and Colombia. In the eastern Pacific, it has been reported from Colombia (Sowerby, 1832), Ecuador (Dall, 1909), and Peru (Pilsbry, 1892b; Dall, 1909; Berry, 1956); it is here recognized, also, at Cabo San Lucas, Mexico, Costa Rica, and Panama. Hence, *S. boogii* ranges from Bermuda (32°20'N) (AJF 331–341) to Alagoas, Brazil (10°34'S) (ZU 47), and from St. Lucie Inlet, Florida (80°01'W) (IRCZM 61:021) to the coast of Brazil (32°12'W) (ZU 47). Bathymetric range, 2–64 m (MORG 20060).

In the eastern Pacific, *S. boogii* ranges from Bahía de los Angeles, Gulf of California, Mexico, to Peru (Thorpe *in* Keen, 1971); northernmost verified record, Cabo de San Lucas, Baja California, Mexico (22°50'N) (LACM 66-17); southernmost verified record, Pacora Is., Bahía Herradura, Panama (7°44'N) (LACM-AHF 245-34). Bathymetric range 0–40 m.

Remarks.—The allocation of *Ischnochiton boogii* Haddon, 1886 to *Stenoplax* seems justified on account of its (1) round-backed, elongated shape with body width/length ratio < 0.5, (2) lateral areas well defined, modestly raised, widely separated at jugum, (3) posterior valve longer than anterior valve, (4) girdle scales, small and striated, (5) sinus, relatively wide, and (6) articulamental and radular features compatible with those of congeneric species. Dall (1919) and Berry (1956) apparently arrived at the same conclusion on assigning the synonymous species, *aethonus* and *isoglypta,* respectively, to the genus.

Thorpe (*in* Keen, 1971) and Abbott (1974) treated *Ischnochiton aethonus* as a synonym of *Chiton rugulatus* Sowerby, 1832. Examination of the respective types clearly demonstrated the inappropriateness of their actions (Ferreira, 1983b).

Ischnoplax Dall, 1879

Type Species.—*Chiton pectinatus* Sowerby, 1840a, by original designation.

Ischnoplax pectinata (Sowerby, 1840a)

Chiton pectinatus Sowerby, 1840a: 288, Suppl. pl. 16, fig. 3; 1840b: 2, no. 8, fig. 146.
Ischnochiton (Ischnoplax) pectinatus (Sowerby). Pilsbry, 1892a: 64–65, pl. 17, figs. 25–30.
Chiton multicostatus Adams, 1845: 8.
Chiton acutiliratus Reeve, 1847, pl. 8, sp. no. 46.
Gymnoplax spiciferus Rochebrune, 1884: 36.
Callistochiton incurvatus Leloup, 1953: 9–13, figs. 6–7.

Material from Barbados.—River Bay, at 1–2 m, 7 specimens, max. 16 mm (AJF 680); Six Men's Bay, at 1–2 m, 1 specimen, 15 mm long (AJF 682); Bathsheba, 5 specimens, max. 35 mm (CAS 012863).

Distribution.—*Ischnoplax pectinata* has been reported from Barbados (Reeve, 1847; Pilsbry, 1892a; Thiele, 1910b; Conde, 1966), Key West, Florida (Dall, 1883), Cuba (Sowerby, 1840a; Pilsbry, 1892a), Jamaica (Adams, 1845), St. Eustatius (Kaas, 1972), Guadeloupe (Saussaye, 1856; Rochebrune, 1884; Pilsbry, 1892a), Panama (Olsson and McGinty, 1958), Colombia (Götting, 1973), Aruba (Kaas, 1972), Trinidad (Baboolal et al., 1981), and Amapa to Santa Catarina, Brazil (Smith, 1890; Leloup, 1953; Righi, 1967; 1971); in addition, it is here recognized in Tobago, St. Lucia, and Costa Rica. Thus, it ranges from Key West, Florida (24°33'N) to Armação, Santa Catarina Is., Brazil (27°40'S) (ZU), and from Costa Rica (83°02'W) (LACM 64-23) to Barbados (59°37'W).

Bathymetric range, 1–3 m.

Remarks.—*Ischnoplax* Dall, 1879, here raised to generic level, was introduced as a subgenus of *Ischnochiton* Gray, 1847, and defined as "Like *Stenoplax* ["body elongate"], but with occasional large [girdle] scales rising above the rest, and a multitude of short striated bristles. Mucro raised, subposterior" (Dall, 1879: 330). The definition was later enlarged by Pilsbry (1892a: 64): "Body elongated, elevated, the valves having high sutural plates and strongly elevated lateral areas; mucro posterior, elevated; girdle clothed with very minute imbricating scales and having larger conspicuous striated scales scattered among them."

The study of the Brazilian fauna disclosed that *Ischnochiton lopesi* Kaas, 1974a, based upon a single, small specimen from Camburiú, SC, Brazil, belongs also in *Ischnoplax* as shown through examination of the holotype (RMNH 55007). Several specimens from Brazil (ZU 69-74) erroneously cited by Righi (1971: 133, 141) as "*Callistochiton shuttleworthianus* Pilsbry, 1892," demonstrated further that *I. lopesi* also has the same two kinds of scales seen in *I. pectinata.* It is to be noted, however, that in both species of *Ischnoplax* the number of large scales is extremely variable. This variability, seemingly unrelated to locality or depth, appears to be somewhat a function of the size (age) of the specimen. In "growth series" of *I. pectinata* and *I. lopesi* it was observed that very small specimens (such as in the holotype of *I. lopesi*) may have no large scales or only a very few, suggesting their random appearance in later life as a form of allometric growth. A very similar phenomenon has been observed in *Stenoplax corrugata* Carpenter *in* Pilsbry, 1892b, an eastern Pacific species, whose minute girdle scales may grow disproportionately to become large triangular spinelets (Ferreira, 1983b), a trans-

formation which, incidentally, misled Berry (1956) into the description of a different species, *S. circumsenta.*

The lectotype of *Chiton multicostatus* Adams, 1845 (USNM 64425) was previously described (Ferreira, 1978: 85, figs. 7–8).

The type material of *Gymnoplax spiciferus* Rochebrune, 1884 (at MNHN) consists of two specimens, preserved dry, flat, soft parts removed, measuring (including girdle) 26.3 × 10.0 mm, and 23.1 × 11.5 mm. They conform with Rochebrune's (1884: 36) very uninformative description [the given dimensions, 29 × 12 mm, obviously refer to a specimen other than either of these two], and the current concept of *I. pectinata* (Sowerby, 1840a).

Family CALLISTOPLACIDAE Pilsbry, 1893

Ceratozona Dall, 1882a

Type Species.—*Chiton guildinguii* Reeve, 1847 [=*Chiton squalidus* Adams, 1845] by original designation.

Ceratozona squalida (Adams, 1845)

Chiton squalidus Adams, 1845: 8.
Ceratozona squalida (Adams). Warmke and Abbott, 1961: 214, fig. 33c.
Chiton setosus Wood, 1828 [not Tilesius, 1824].
Chiton setosus Sowerby *in* Broderip and Sowerby, 1832: 27–28 [not Tilesius, 1824; ? not Wood, 1828].
Chiton rugosus Sowerby, 1840b, no. 6, fig. 49 [not Gray, 1826].
Chiton guildingii Reeve, 1847, pl. 21, fig. 138.
"*Ch. bicolor,* Adams" Gray, 1847a: 67.
Ceratozona angusta Thiele, 1909: 21, pl. 2, figs. 74, 75. [new name for *Chiton setosus* Sowerby, 1832 (not Tilesius, 1824)].

Material from Barbados.—Paradise Beach, St. Michael, 11 specimens, max. 34 mm (AJF 679); Maycock's Bay, 3 specimens, max. 24 mm (AJF 684); near "Maresol Hotel," 2 specimens, 35 mm long (AJF colln., *leg.* B. Keegan).

Distribution.—*Ceratozona squalida* is present both in the Caribbean and tropical eastern Pacific. In the Caribbean, it has been reported from Barbados (Conde, 1966; Kaas, 1972), east coast of Florida (Dall, 1889a; Pilsbry, 1893; Smith, 1937; Leloup, 1942b; Warmke and Abbott, 1961; Kaas, 1972), Puerto Rico (Pilsbry, 1893; Dall and Simpson, 1901), Martinique (Leloup, 1942), Cuba (Leloup, 1942b), Grand Cayman Is. (Abbott, 1958), Jamaica (Adams, 1845), St. Vincent (Reeve, 1847; Dall, 1889a), Bahamas, St. John, Saba, St. Eustatius, Montserrat, Grenada, Tobago, Curacao, Aruba, and Venezuela (Kaas, 1972), Colombia (Götting, 1973), and Trinidad (Reeve, 1847; Dall, 1889a; Kaas, 1972; Baboolal et al., 1981); in addition, it is here recognized at Dominican Republic, and Cozumel. Thus, it ranges from Seminole Shores, Florida (27°10′N) (IRCZM 61:004; IRCZM 61: 005; IRCZM 61:017) to Trinidad (10°30′N), and from Cozumel (86°55′W) (AJF 514) to Barbados (59°37′W).

In the eastern Pacific, *C. squalida* was reported (as *C. angusta*) from El Salvador to Panama (Thorpe *in* Keen, 1971). However, such range has not been corroborated; southernmost verified record, Tortugas Is., Puntarenas, Costa Rica (9°27′N) (AJF colln., *leg.* A. J. Ferreira); northernmost verified record, Poreloya, Nicaragua (12°23′N) (AJF 131).

Bathymetric range, on both coasts, 0–1 m.

Remarks.—The naming of this species has had a checkered course: (1) Wood (1828) first named the Caribbean ("W. Indies") population *Chiton setosus* [not

Table 1. Specimens of *Ceratozona squalida* from Caribbean and eastern Pacific populations, compared on frequency of body width/length ratios, and index of body curvature

Body width/length	Pacific n = 24	Caribbean n = 23
0.44–0.46	4	
0.47–0.49	2	
0.50–0.52	8	2
0.53–0.55	2	3
0.56–0.58	5	4
0.59–0.61	2	2
0.62–0.64	1	7
0.65–0.67		5
Mean	0.52	0.60
SD	0.05	0.05
(Student's $t = 5.18$, df = 45, $P < 0.001$)		
	Body Curvature Index*	
	n = 6	n = 6
Range	1.5–1.7	1.3–1.5
Mean	1.55	1.42
SD	0.084	0.075
(Student's $t = 2.829$, df = 10, $P < 0.02$, one-tailed)		

* Body Curvature Index = (width of valve v)/(width of valve i).

Tilesius, 1824], laconically described as "yellow-bearded." (2) Sowerby (1832) named eastern Pacific specimens also *Chiton setosus,* either regarding them as Wood's (1828) or unaware of the name's previous use. (3) Sowerby (1840b, fig. 49) introduced *Chiton rugosus,* attributed to Gray, for a *Ceratozona*-like specimen of unstated locality. [Gray (1826) had used *C. rugosus* (nomen nudum) for an Australian species.] (4) Adams (1845) described the species anew in the Caribbean (Jamaica) as *Chiton squalidus.* (5) Reeve (1847) described the species in the Caribbean (St. Vincent) as *Chiton guildingii,* including [? replacing] the preoccupied name *C. setosus* Wood. (6) Reeve (1847) recognized "*Chiton rugosus* Gray" [after Sowerby, 1840b] in the Caribbean (St. Vincent and Trinidad), adding "*Chiton bicolor,* Adams" [Gray, 1847a, a nomen nudum] to its synonymy, and pointing out that the posterior valve is "umbonated and abruptly retuse" in Pacific specimens, but "slanting" in Caribbean's. (7) Pilsbry (1892) reduced the number of putative *Ceratozona* species to two, *C. rugosa* (Sowerby) [with *C. guildingii* as syn.] in the Caribbean, and *C. setosa* (Sowerby) in the Pacific, despite having seen no specimens of the latter. (8) Thiele (1909) affirmed that the Caribbean and Pacific populations of *Ceratozona* were of distinct species, to be known as *C. rugosa* and *C. angusta* (new name for *C. setosa*), respectively, and that specimens of the latter were "easily distinguishable" from their Caribbean counterparts for their more beaked valves and more elongated (narrower) body. (9) Ferreira (1978) pointed out that *Ceratozona squalida* (Adams) was the proper name for the Caribbean population since the name *rugosus* was preoccupied.

No recognizable differences were found here between Pacific and Atlantic specimens. Reeve's (1847) and Thiele's (1909) criteria are insufficient to segregate specimens of the two populations. Although, as first noted by Thiele (1909), Pacific specimens are, on average, narrower and more parallel-sided than Atlantic specimens (Table 1), this statistical finding does not seem sufficient to justify the notion of two species. The genus *Ceratozona* appears, thus, as monotypic.

Family allocation for *Ceratozona* is still unresolved. The insertion teeth—thickened at the edges, and corresponding to tegmental radial ribs—have induced authors (Pilsbry, 1893c; Smith, 1960; Van Belle, 1983) to group *Ceratozona* with *Callistochiton* in Callistoplacidae; but the presence of chitinous spinules ("hairs") in the girdle, 8-slitted end valves, and a tricuspid radula, have decided others (Bergenhayn, 1955; Kaas, 1972) to locate it in Mopaliidae, instead. For the moment, there seems to be no compelling argument to decide the issue either way. Perhaps such were the uncertainties that led Pilsbry (1893c: 293) to speculate, "The ancestors of Mopaliidae were Callistoplacinae, probably not very different from the recent genus *Ceratozona*."

Family CHITONIDAE Rafinesque, 1815

Chiton Linnaeus, 1758

Type Species.—*Chiton tuberculatus* Linnaeus, 1758, by subsequent designation (Dall, 1879).

Chiton tuberculatus Linnaeus, 1758

Chiton tuberculatus Linnaeus, 1758: 667.
Chiton tuberculatus ater Pilsbry, 1893b: 155, pl. 33, fig. 63.
Chiton undatus Spengler, 1797: 68.
Chiton assimilis Reeve, 1847, pl. 14, sp. and fig. 77.

Material from Barbados.—River Bay, 1 specimen, 50 mm long (ZMUC, *leg.* J. Knudsen); Bathsheba, 3 specimens, max. 40 mm (CAS 012320).

Distribution.—*Chiton tuberculatus* has been reported from Barbados (Pilsbry, 1893b; Thiele, 1910b; Lewis, 1960; Conde, 1966), Bermuda (Pilsbry, 1893b; Heilprin, 1889; Crozier, 1918), Florida (Pilsbry, 1893b; Smith, 1937), Puerto Rico (Dall and Simpson, 1901; Glynn, 1970), St. Kitts (Pilsbry, 1893b; Kaas, 1972), St. Croix (Spengler, 1797), St. Thomas (Spengler, 1797; Pilsbry, 1893b; Nierstrasz, 1905b; Kaas, 1972), Curacao (Nierstrasz, 1927; Righi, 1968; Kaas, 1972), Cayman Is. (Abbott, 1958), Cuba, Anguilla, Saba, St. Eustatius, Dominica, Tobago, Bonaire, Klein Bonaire, Aruba, Venezuela (Kaas, 1972), Colombia (Dautzenberg, 1900; Götting, 1973), Trinidad (Kaas, 1972; Baboolal et al., 1981), and Panama (Olsson and McGinty, 1958; Glynn, 1970); in addition, it is here recognized in Bahamas, Jamaica, St. Lucia, Honduras, Nicaragua, Cozumel, Antigua, and Dominican Republic. Thus, it ranges from Bermuda (32°20′N) to Trinidad and Panama (9°33′N), and from Cozumel (86°55′W) to Barbados (59°37′W). Reports of the species in Texas (Pilsbry, 1893b; Smith, 1937) have not been corroborated.

Bathymetric range, 0–4 m.

Remarks.—*Chiton bistriatus* Wood, 1815, and *Chiton tessellatus* Wood, 1815 have been regarded as synonyms of *C. tuberculatus* by authors (Pilsbry, 1893b; Kaas, 1972). However, *C. bistriatus* is "evidently different from the true *Chiton squamosus*" (Wood, 1815: 7) of Born (1780) [=*C. tuberculatus* Linnaeus], and *C. tessellatus* lacks sufficient descriptive elements for assignment to a known taxon. It is here recommended that the two names be cast aside as nomina dubia, instead.

Chiton marmoratus Gmelin, 1791

Chiton marmoratus Gmelin, 1791: 3205.
Chiton scarabaeus Reeve, 1847, pl. 12, sp. and fig. 66.

Material from Barbados.—Paradise Beach, 10 specimens, max. 27 mm (AJF 679); St. Lawrence, 6 specimens, max. 52 mm (AJF 683; ZMUC); near "Maresol Hotel," 3 specimens (AJF colln., *leg.* B.

Keegan); River Bay, 5 specimens, max. 35 mm (ZMUC); Bathsheba, 5 specimens, max. 20 mm (CAS 012302).

Distribution.—*Chiton marmoratus* has been reported from Barbados (Pilsbry, 1893b; Thiele, 1910b; Lewis, 1960; Conde, 1966; Kaas, 1972), Cuba (Pilsbry, 1893; Aguayo and Jaume, 1947), Guadeloupe (Saussaye, 1856), Grand Cayman Is. (Abbott, 1958), Jamaica, St. Thomas, St. Croix, St. Vincent (Pilsbry, 1893b), Puerto Rico (Dall and Simpson, 1901; Glynn, 1970), Curacao (Horst and Schepman, 1908; Nierstrasz, 1927; Kaas, 1972), St. John, Saba, Antigua, St. Eustatius, Montserrat, Grenada, Tobago, Bonaire, Klein Bonaire, Aruba, Venezuela (Kaas, 1972), Trinidad (Dall, 1889a; Kaas, 1972; Baboolal et al., 1981), Colombia (Pilsbry, 1893b; Götting, 1973), and Panama (Olsson and McGinty, 1958; Glynn, 1970); in addition, it is here recognized at Dominican Republic and Honduras. Thus, it ranges from Cuba (20°30'N) to Panama (9°33'N), and from Roatan Is., Honduras (86°35'W) (CAS 010084) to Barbados (59°37'W). Heilprin's (1889) report of *C. marmoratus* in Bermuda, echoed by others (Dall, 1889; Pilsbry, 1893b; Kaas, 1972), is probably in error; the species was not found in field work (A. J. Ferreira and W. E. Daily collecting trip to Bermuda, May 1977), or museum material (Bermuda Aquarium, Natural History Museum, and Zoo, David D. Lonsdale, Curator; chiton collection on loan, September 1979). Reports of the species in Texas (Dall, 1889a) and Florida Keys (Smith, 1937) also require corroboration.

Bathymetric range, 0–1 m.

Remarks.—*Chiton marmoratus* resembles the eastern Pacific *C. articulatus* Sowerby, 1832, from which it differs in the different coloring, wider sinus, "the conspicuously porous [slit-rays]" (Pilsbry, 1893b: 159), and the radula (Ferreira, 1983b).

Chiton viridis Spengler, 1797

Chiton viridis Spengler, 1797: 70, pl. 6, fig. 5.
Chiton foveolatus Sowerby, 1840a: 290; 1840b, no. 16, fig. 60.
Chiton costatus Adams, 1845: 8.
Chiton (Lophurus) gemmulatus Shuttleworth, 1853: 75.
Chaetopleura reesi Salisbury, 1953: 41, pl. 7.

Material from Barbados.—River Bay, 1 specimen, 20 mm long (ZMUC, *leg.* Chr. Frandsen).

Distribution.—*Chiton viridis* has been reported from Barbados (Kaas, 1972), Bimini (Kaas, 1972), Cuba (Aguayo and Jaume, 1947), Puerto Rico (Dall and Simpson, 1901; Warmke and Abbott, 1961), St. John, St. Martin, St. Barts, Barbuda (Kaas, 1972), St. Thomas (Pilsbry, 1893b; Thiele, 1910b; Kaas, 1972), St. Croix (Pilsbry, 1893b), Grand Cayman (Salisbury, 1953; Abbott, 1958; Kaas, 1972), Jamaica (Adams, 1845; Pilsbry, 1893b; Kaas, 1972), Curacao (Nierstrasz, 1927; Kaas, 1972), Aruba and Bonaire (Kaas, 1972), Panama (Olsson and McGinty, 1958); in addition, it is here recognized at Bahamas, Dominican Republic, Antigua, St. Lucia, and Colombia. Thus, it ranges from Grand Bahama Is. (26°40'N) (AJF colln., *leg.* A. J. Ferreira) to Colon, Panama (9°22'N), and from San Andrés Is., Colombia (81°42'W) (LACM 70-25) to Barbados (59°37'W). The presence of the species at Tobago, Trinidad, and Venezuela (Kaas, 1972), has not been verified.

Bathymetric range, 0–1 m.

Remarks.—Juvenile specimens of *C. viridis* are bright red in color (P. Kaas, pers. comm., in litt., 9 Sept. 1977) as observed here in three specimens: One, 5.4 mm long, from St. Andrés Is., still sculptureless, uniformly brick red, except for small

bluish discolorations at periphery of lateral and pleural areas; girdle banded bright red and white. The other two specimens, from St. Lucia (9 mm long) and Jamaica (10 mm long), already show tegmental sculpture; both brick red along jugal area, but grayish blue at periphery; girdle with few red scales amidst dark-gray ones.

Tonicia Gray, 1847a

Type Species.—*Chiton elegans* Frembly, 1827 (not Blainville, 1825) [=*Chiton chilensis* Frembly, 1827], by subsequent designation (Gray, 1847c).

Tonicia schrammi (Shuttleworth, 1853)
Figure 10

Chiton (*Tonicia*) *schrammi* Shuttleworth, 1853: 171, pl. 6, fig. 9.

Material from Barbados.—Bellairs Reef, Holetown, at 20 m, 2 specimens, max. 27.5 mm (AJF 681); "west coast," at 25–30 m, 4 specimens, max. 27 mm (AJF colln., *leg.* R. G. Bromley); Drummer Hole, off Holetown, at 21 m, 1 specimen, 23 mm long (Fig. 10), on undersurface of living *Porites asteroides* (AJF colln., *leg.* Tina Ortiz).

Distribution.—*Tonicia schrammi* has been reported from Key West, Florida (Dall, 1889a), Puerto Rico (Glynn, 1970), Guadeloupe (Shuttleworth, 1853; Saussaye, 1856), Aruba (Kaas, 1972), and Curacao (Nierstrasz, 1927; Kaas, 1972); in addition it is here recognized at Barbados, Bahamas, Cuba, Grand Cayman Is., Jamaica, Virgin Islands, Antigua, Bonaire, Honduras and Colombia. Thus, it ranges from San Salvador Is., Bahamas (24°00'N) (AJF 439; AJF 441) to Baru Is., off Cartagena, Colombia (10°25'N) (AJF 315), and from Roatan Is., Honduras (86°35'W) (AJF 311; AJF 312; AJF 315) to Barbados (59°37'W). The report of the species at Bermuda (Heilprin, 1889) has not been verified.

Bathymetric range, 0–35 m.

Remarks.—*Tonicia schrammi* is the only representative of the genus in the western Atlantic.

Acanthopleura Guilding, 1829

Type Species.—*Chiton spinosus* Bruguière, 1792, by subsequent designation (Gray, 1847c).

Acanthopleura granulata (Gmelin, 1791)

Chiton granulatus Gmelin, 1791: 3205.
Acanthopleura granulata (Gmelin). Haddon, 1886: 24–28.
Chiton piceus Gmelin, 1791: 3205.
Chiton salamander Spengler, 1797: 80–81.
Chiton convexus Blainville, 1825: 544.
Chiton occidentalis Reeve, 1847, pl. 14, sp. and fig. 76.
Chiton (*Acanthopleura*) *mucronulatus* Shuttleworth, 1853: 79.
Chiton (*Acanthopleura*) *blauneri* Shuttleworth, 1856: 170–171.

Material from Barbados.—Paradise Beach, 6 specimens, max. 55 mm (AJF 679); River Bay, 9 specimens, max. 40 mm (AJF 680; ZMUC); St. Lawrence, 14 specimens, max. 50 mm (AJF 684; ZMUC); Bathsheba, 1 specimen, 35 mm long (CAS 012260).

Distribution.—*Acanthopleura granulata* has been reported from Barbados (Thiele, 1910b; Lewis, 1960; Conde, 1966; Kaas, 1972), St. Martin (Coomans, 1963), Curacao (Nierstrasz, 1927; Kaas, 1972), Puerto Rico (Glynn, 1970), Cuba (Orbigny, 1853), West Florida (Smith, 1937) Florida Keys, North Bimini, Bahamas, Haiti, Puerto Rico, St. John, St. Croix, Anguilla, St. Martin, St. Barts, Saba, St. Eustatius, St. Kitts, Barbuda, Antigua, Guadeloupe, Grenada, Tobago, Bonaire, Klein Bonaire, Aruba (Kaas, 1972), Cozumel (Hidalgo, 1956), Grand Cayman

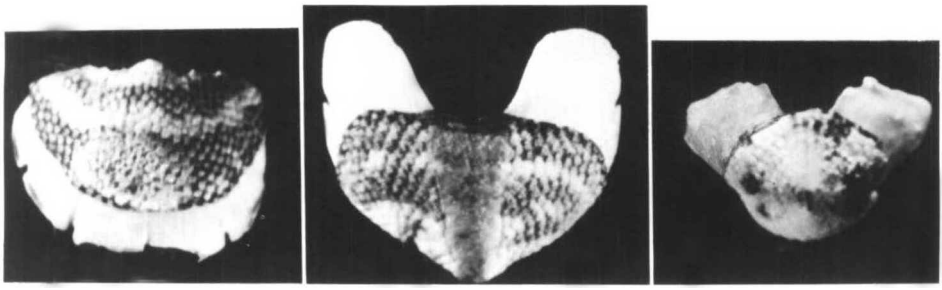

Figure 12. (Left) *Acanthochitona astrigera* (Reeve, 1847). Carlisle Bay, Barbados; specimen 5.5 mm long. Anterior valve. Figure 13. (Center) Same specimen as in Figure 12: Intermediate (iv) valve. Figure 14. (Right) Same specimen as in Figure 12: Posterior valve.

(Abbott, 1958), Panama (Olsson and McGinty, 1958; Glynn, 1970), Colombia (Götting), and Trinidad (Kaas, 1972; Baboolal et al., 1981); in addition, it is here recognized at Jamaica, Dominican Republic, St. Lucia, Honduras, Nicaragua, and Venezuela. Thus, it ranges from West End, Grand Bahama Is. (26°41′N) (AJF colln., *leg.* A. J. Ferreira) to the northern coast of Panama (9°20′N) and Trinidad (10°30′N) (AJF 668), and from Cozumel (86°55′W) to Barbados (59°37′W). Reports of the species in the Magellan Strait (Nierstrasz, 1905a; 1905b) and Cape of Good Hope (Nierstrasz, 1905b) are obviously in error. Reports of *A. granulata* in Bermuda (Dall, 1889a; Pilsbry, 1893c; Peile, 1926; Kaas, 1972), are presumed in error; they have not been supported by field work (A. J. Ferreira and W. E. Daily collecting trip to Bermuda, May 1977; Dr. John S. Pearse, pers. comm. upon field trip to Bermuda, July 1980) or museum material (Bermuda Aquarium, Natural History Museum, and Zoo, David D. Lonsdale, Curator: chiton collection on loan, September 1979). Reports of *A. granulata* at Charlotte Harbor, Florida (Dall, 1889a), Texas and Suriname (Kaas, 1972) have not been verified.

Bathymetric range, 0–1 m.

Remarks.—*Chiton magellanicus* Gmelin, 1791, and *C. unguiculatus* Blainville, 1825, are here cast aside as nomina dubia. *Chiton magellanicus* Gmelin, 1791: 3204, supposedly from Magellan Strait, based upon figs. 797 and 798 in Chemnitz (1785, 8: 279, pl. 95), has been variably interpreted as an Australian acanthopleurid (Rochebrune, 1889), a South African species (Nierstrasz, 1905a; 1906), and *A. granulata* from West Indies (Pilsbry, 1893c; Kaas, 1972; Kaas and Van Belle, 1980). Examination of Chemnitz' (op. cit.) figures reveals that the *Acanthopleura* species it represents cannot ever be identified with certainty.

Chiton unguiculatus Blainville, 1825: 544, lacks locality, and adequate description to differentiate it from most other species of *Acanthopleura.*

Family ACANTHOCHITONIDAE Pilsbry, 1893e

Acanthochitona Gray, 1821

Type Species.—*Chiton fascicularis* Linnaeus, 1767, by monotypy.

Acanthochitona astrigera (Reeve, 1847)
Figures 11–15

Chiton astriger Reeve, 1847, specimen 109, pl. 18.
Phakellopleura (*Acanthochites*) *astrigera* (Reeve). Shuttleworth, 1853: 79.

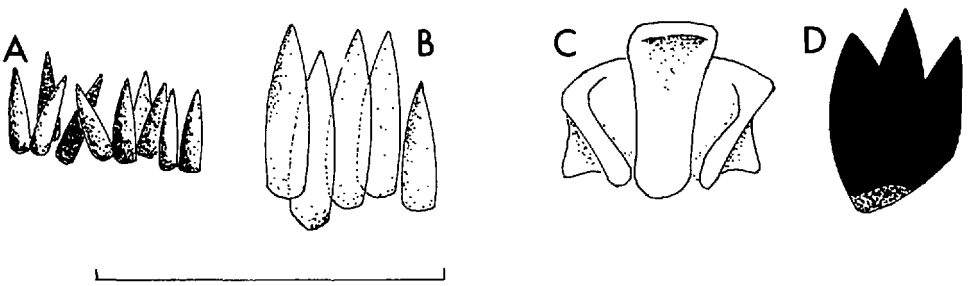

Figure 15. Same specimen as in Figure 12: A. Spicules of upper surface of girdle. B. Spiculoid scales of undersurface of girdle. C. Median and first lateral teeth of radula. D. Head of major lateral tooth of radula. Scale 100 μm.

Material from Barbados.—Nursery's Jetty, at 17 m, 1 specimen, 4.7 mm long (Fig. 11) (ZMUC, *leg.* J. Knudsen); Carlisle Bay, at 4–5 m, 1 specimen, 5.5 mm long (Figs. 12–14) (ZMUC, *leg.* J. A. Christiensen); St. Lawrence, at 0.25 m, 1 specimen, 4.1 mm long (ZMUC, *leg.* J. Just).

Description.—Barbados specimens here regarded as topotypes of *A. astrigera,* much resemble specimens of *A. spiculosa,* except for smooth jugal area. Up to 5.5 mm long [largest specimen of *A. astrigera* examined, 15 mm long (IRCZM 61:052: Carrie Bow Cay, Belize], reddish-brown tegmentum, beaked valves; jugal area smooth, wider in front, sides diverging at 15° (on valve iv), prolonged posteriorly into beak; latero-pleural areas with round to oval, flat to concave granules, about 60 μm in diameter, 10–20 μm apart; posterior edges of valve iv at 115° angle; tegmental surfaces of valve i, width/length = 1.57, of valve iv = 1.59, of valve viii = 1.04; posterior valve roundish; mucro well defined, slightly posterior; postmucro sloped at 30°. Gills merobranchial, along posterior ½ of foot. Articulamentum white; sutural laminae well developed, rather elongated; sinus deep, relatively narrow; slits well defined, 5–1–2. Girdle with fine, pointed, equal-sized, yellowish, translucent spicules (Fig. 15A), 20–30 μm long, 2–3 μm wide; sutural tufts of abundant (50+), crowded, white, glassy, pointed, spicules, up to 300 μm long, 20 μm wide; undersurface with imbricated, transparent, spiculoid scales (Fig. 15B), 50 × 10 μm; marginal fringe of glassy spicules, up to 150 μm long, 20 μm thick. Radula [very similar to that of *A. spiculosa*] 2.6 mm long, comprising 30 rows of mature teeth; median tooth rectangular, 30 μm wide at small anterior blade (Fig. 15C); head of major lateral teeth, tricuspid (Fig. 15D), 50 μm wide; outer-marginal teeth, 50 μm long, 40 μm wide.

Distribution.—*Acanthochitona astrigera* is here recognized at Barbados (type locality), Aruba, Belize, and Panama, in depths of 0 to 41–43 m. Although often listed by authors (Shuttleworth, 1853; Dall, 1889a; Smith, 1890; Pilsbry, 1893e; Thiele, 1893; Sykes, 1894; Dall and Simpson, 1901; Nierstrasz, 1927; Peile, 1926; Johnson, 1934; Smith, 1937; Aguayo and Jaume, 1947; Watters, 1981), the lack of descriptions or illustrations makes it impossible to know what biological species were so called. The specimens cited and illustrated by Watters (1981) as "*Acanthochitona astriger*" from Puerto Rico (pl. 2, fig. d) and Virgin Islands (pl. 4, fig. h), though insufficiently characterized, seem to conform with the concept of *A. astrigera* here expressed, suggesting a range wider than the southern half of the Caribbean.

Remarks.—Since Smith (1890: 496) and Pilsbry (1893e, 15: 22–23), most chiton workers have regarded *Chiton astriger* Reeve, 1847, as a synonym or subspecies

of *Chiton spiculosus* Reeve, 1847, overlooking two important points: (1) Reeve's (op. cit.) statement that *C. astriger* is "smooth along the summit [=jugum]," and (2) the distinctly different illustrations of *spiculosa* (sp. 47, pl. 9) and *astriger* (sp. 109, pl. 18). The finding of specimens of *Acanthochitona* in Barbados (type locality of *Chiton astriger*), with a smooth (i.e., not longitudinally striated) jugum raises the question anew.

A striated jugal surface seems to be a constant feature of *A. spiculosa*: in a lot of 73 specimens from Long Is., Bahamas (AJF 230), as small as 6 mm long, a striated jugum was observed in 100% of the cases.

Thus, for their well defined, smooth jugum, the Barbados specimens are not only clearly distinct from *A. spiculosa,* but also from (1) *A. bonairensis* Kaas, 1972, with striated jugum, (2) *A. brunoi* Righi, 1971, from northern Brazil, with extremely wide jugum and large latero-pleural granules, as confirmed by examination of a paratype (ZU 81), and (3) *A. minuta* (Leloup, 1980), also from northern Brazil, with indistinct and granule-covered jugal area.

Since a smooth jugum is also present in *Choneplax lata,* to avoid potential confusions in identification, particularly where juvenile specimens of *C. lata* are concerned, it should be stressed that the two species clearly differ in the (1) granules of the latero-pleural areas and end valves (flat-concave in *A. astrigera*; convex in *C. lata*), (2) articulamental slits (wider and deeper in *A. astrigera* than in *C. lata*), and (3) spicules at sutural tufts (abundant, thin, white in *A. astrigera*; scarce, thick, usually yellow-brown in *C. lata*).

Acanthochitona rhodea (Pilsbry, 1893d)

Acanthochites rhodeus Pilsbry, 1893d: 32; 1983e, 15: 26, pl. 12, figs. 48–51.
Acanthochites (*Notoplax*) *hemphilli* Pilsbry, 1893d: 32; 1893e, 15: 34, pl. 13, figs. 65–67.

Material from Barbados.—River Bay, 1–2 m, 1 specimen, 11 mm long (AJF 680).

Distribution.—*Acanthochitona rhodea* is present both in Caribbean and tropical eastern Pacific. In the Caribbean *A. rhodea* has been reported from Key West, Florida (Pilsbry, 1893d; Smith, 1937), Dry Tortugas, Florida (Kaas, 1972), "Florida Keys and West Indies" (Abbott, 1974, as *Craspedochiton hemphilli*), Culebra (Dall and Simpson, 1901), Grand Cayman Is. (Salisbury, 1953), Curacao (Righi, 1968; Kaas, 1972), Aruba (Kaas, 1972), Cabo la Vela, Colombia (Leloup, 1941), Panama (Olsson and McGinty, 1958; Glynn, 1970), and Brazil (Righi, 1971); in addition, it is here recognized at Bahamas, Cuba, Dominican Republic, Virgin Islands, Jamaica, Bonaire, Belize, and Venezuela. Thus, it ranges from New Providence Is., Bahamas (25°05'N) (LACM A.2777) to Brazil (17°16'S) (ZU 96), and from Dry Tortugas, Florida (82°55'W) to Barbados (59°37'W) (AJF 680). Bathymetric range, 0–115 m (Righi, 1971: ZU 96).

In the eastern Pacific, it was reported from Acapulco, Mexico, to Peru (Thorpe *in* Keen, 1971); it is here recognized in Guaymas, Sonora, Mexico (27°56'N), El Salvador, Costa Rica, Nicaragua, Panama, and Independencia Bay, Peru (14°13'S). Bathymetric range, 1–15 m.

Remarks.—From descriptions and illustrations alone, it is easy to conclude that Pilsbry's (1893d) *Acanthochites rhodeus* and *A. hemphilli* are conspecific. As revealed in this study, the presence or absence of "slits or nicks" in the posterior valve to which Pilsbry (op. cit.) attributed great taxonomic importance are of no consequence. Irregular in number, size, and location, nicks and slits have been thought characteristic of *A. interfissa* Kaas, 1972 [=*Choneplax lata*], and observed here in occasional specimens of *A. spiculosa.*

No consistent differences were found here between Caribbean and Pacific specimens except in the width/length of tegmentum of posterior valve: In Caribbean specimens, mean = 0.93 (N = 4); in Pacific specimens, mean = 1.09 (N = 4) ($P < 0.001$). Several intraspecific variations, though not related to locality or depth, are worthy of note: In *A. rhodea* the (1) girdle may appear almost naked to the unaided eye to pubescent or "hairy," depending on the length of the spiculoid elements, (2) spicules of sutural tufts and fringe may vary in color (white, bronze, green, or purple) and size, (3) jugal area may be clearly raised to flush, parallel sided to slightly wider anteriorly or posteriorly, (4) latero-pleural and end valves' pustules may be significantly smaller towards jugum, and at the apex, (5) posterior valve may be somewhat raised to flat.

The type locality of *A. rhodea* was given as "Panama (McNeill Expedition)" (Pilsbry, 1893e: 27) with no indication whether "Panama" referred to the Atlantic, Pacific, or both coasts. Efforts to ascertain the collecting sites of the "McNeill Expedition," seemingly responsible for the type specimens, have been fruitless. John D. McNiel [sometimes misspelled McNeil, or McNeill], amateur conchologist, did collect "in Nicaragua and South America" (American Malacologists, 1974: 133); but whether his travelings took him to the Atlantic, Pacific, or both coasts of Panama, could not be determined. The finding of the two names, *rhodeus* (page priority) and *hemphilli,* in synonymy remedies the difficulty. The type locality of *A. rhodea* is here restricted to Portobelo, Panama, a Caribbean site where the species has been found with relative abundance.

The radula of *A. rhodea* is indistinguishable from that of *A. spiculosa,* despite Righi's (1968: 75) statement to the contrary; it averages 33% of specimen's length (N = 10), and 47 rows of mature teeth (range 33–60).

Choneplax Dall, 1882a

Type Species.—*Chiton strigatus* Sowerby, 1840a [=*Chitonellus latus* Guilding, 1829], by original designation.

Choneplax cf. *C. lata* (Guilding, 1829)
Figures 16, 17 and 18

Chiton latus Guilding, 1829: 28.
Choneplax lata (Guilding). Pilsbry, 1893e: 60, pl. 8, fig. 15.
Chiton strigatus Sowerby, 1840a: 289; 1840b, fig. 63.
Acanthochitona elongata Kaas, 1972: 51–53, figs. 90–94, pl. 2, fig. 3.
Acanthochitona interfissa Kaas, 1972: 53–55, figs. 95–107.
Acanthochitona andersoni Watters, 1981: 173–177, pl. 2, figs. e, f, g; pl. 4, fig. i).

Material from Barbados.—Bellairs Reef, Holetown, at 12–40 m, 7 specimens, max. 9.3 mm (Figs. 16, 17) (ZMUC, *leg.* R. G. Bromley); Holetown, 1 km N of Bellairs Research Institute, depth unstated, 1 specimen, 4.0 mm long (ZMUC, *leg.* J. Just); Drummer Hole, off Holetown, at 21 m, 4 specimens, max. 6.5 mm (AJF colln., *leg.* Tina Ortiz).

Description.—Barbados specimens, in alcohol, all small, differ appreciably from larger, "typical" specimens. Largest 9.3 mm long, including girdle; cream colored with splashes of bright red and brown; body width/length, mean 0.55; intermediate valves pentagonal, wider than long (tegmentum on valve iv, width/length = 1.6), with angulate posterior edge; jugum smooth, well defined, triangular, wider in front; granules of latero-pleural areas and end valves, round, convex-topped, about 70 μm in diameter, 20 μm apart, in quincunx (in Holetown 4 mm long specimen, granules in 4–5 rows parallel to jugal tract); mucro salient, posterior; postmucro sharply sloped; girdle musculous, encroaching at sutures, with small, equal-sized,

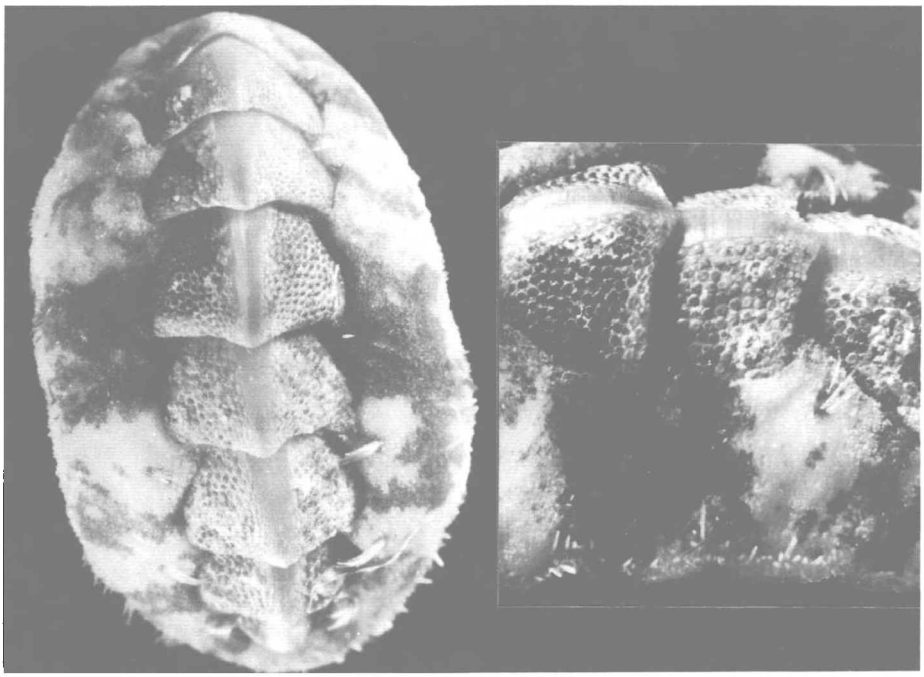

Figure 16. (Left) *Choneplax* cf. *C. lata* (Guilding, 1829). Bellairs Reef, Holetown, Barbados. Specimen 9.3 mm long (in alcohol). Figure 17. (Right) Same specimen as in Figure 16: Side view.

100 × 10 μm, cigar- to club-shaped spicules vaguely striated longitudinally; tufts inconspicuous, with few (5–20), yellowish-brown, glassy, slightly curved spicules; marginal fringe of larger spicules; undersurface with imbricated, translucent, sharply pointed spicules; gills merobranchial, along posterior ⅓ of foot; articulamentum white; sutural laminae relatively long; sinus, narrow, deep; slits 5–1–2, small, inconspicuous; posterior edge of valve viii, recurved forward; radula (of specimen 7.7 mm long) like in *Acanthochitona spiculosa*, 2.2 mm long, comprising 35 rows of mature teeth.

Larger specimens from other localities easily identified (Kaas, 1972): Largest, 33 mm long (including girdle), in alcohol (CAS 014949: Exchange Bay, Antigua); valves thick, elongate; tegmentum on valve iv, width/length = 0.7; mucro prominent, posterior; postmucro sloping rapidly, recurved forward; valves ii–v narrower than valves vi–viii, valves vi or vii consistently the widest (Table 2); jugum poorly defined, smooth, usually eroded; convex-topped granules on end valves and pleural areas of intermediate valves, up to 110 μm in diameter, 30 μm apart; articulamentum dark blue; insertion plate of valve viii recurved forward, thickened; posterior edge of intermediate valves straight or curved. Slits minute on anterior and intermediate valves, often absent on posterior valve; slit formula, 5/3–1/0–2/0; [specimen from Guadeloupe, 20 mm long (ZMUC), 4–1/0–0 slits; specimen from Antigua (CAS 014949), 22 mm long, 5–1–0 slits; specimen from Antigua (CAS 031501), 25 mm long, 5–1/0–0 slits (two slits of anterior valve very reduced in size, almost absent; slits present, progressively smaller from valves ii to iv, absent from valves v to viii)]; girdle twice wider than shell in alcohol preserved specimens, less than ⅓ of shell in dried specimens; sutural tufts with few (20–30) translucent, yellow-brown or (rarely) white spicules, up to 700 × 65

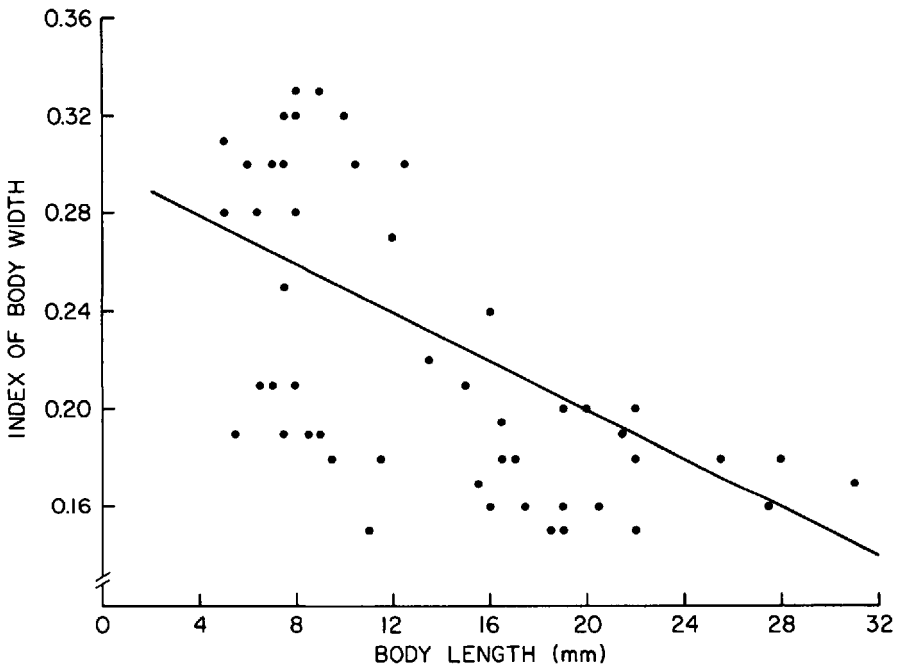

Figure 18. Index of body width (width of largest valve/body length) vs. body length [excluding girdle] in 49 specimens of *Choneplax lata* from several localities ($r = -0.62$; $P < 0.001$; $Y = 0.30 - 0.005X$).

μm, straight to slightly curved; upper surface covered otherwise with spiculoid elements, round ended, cigar- to club-shaped, about 150 × 30 μm, vaguely striated longitudinally; marginal spicules up to 400 × 50 μm; undersurface with imbricated, transparent, spiculoid scales, about 80 × 12 μm. Radula (of specimen 20 mm long), 6.5 mm in length comprising 55 rows of mature teeth; median tooth rectangular, 60 μm at anterior blade; major lateral teeth with tricuspid head 120 μm wide.

Distribution.—*Choneplax lata* has been reported from St. Vincent (Guilding, 1829), St. Thomas and Guadeloupe (Pilsbry, 1893e), Puerto Rico (Pilsbry, 1893e; Warmke and Abbott, 1961), Tobago, St. John, Bonaire and Curacao (Kaas, 1972); in addition, it is here recognized on east coast of Florida and Keys, Bahamas, Antigua, Belize, Venezuela, Panama, and (tentatively) Barbados. Thus, it ranges from St. Lucie Inlet, Florida (27°10'N) (IRCZM 61:007; IRCZM 61:008) to Panama (9°22'N, 80°00'W) (LACM A8-39; AJF colln., *leg.* H. Bertsch), and from Panama to Barbados (59°37'W).

Bathymetric range, 0–18 m.

Remarks.—*Choneplax* Dall, 1882a, was erected to accommodate *Chitonellus latus* Guilding, 1829, to which Pilsbry (1893e) tentatively added *Chiton hastatus* Sowerby, 1840a, a possible synonym of *C. lata* (*fide* Kaas and Van Belle, 1980). Three other species have been allocated to the genus, *C. indica* Odhner, 1919, *C. parva* Leloup, 1981, and a *Choneplax* sp., Leloup, 1981, all from Madagascar.

For its elongated look and tegmental sculpture of convex-topped granules, *C. lata* has seemed so distinct as to warrant generic separation. However, three observations have remained bothersome: (1) the inconsistencies in the reported

Table 2. Width of tegmental surfaces of intermediate valves of specimens of *Choneplax lata* from several localities

Length of specimen (without girdle) (mm)	Width of tegmental surfaces of intermediate valves (mm)					
	ii	iii	iv	v	vi	vii
15.5	1.7	1.8	2.0	2.4	2.7	2.8
15.5	2.9	2.7	2.7	2.7	3.1	3.1
16.5	2.9	2.6	2.9	3.0	3.2	3.1
17.0	1.9	2.0	2.2	2.5	2.4	2.8
19.5	3.3	3.0	3.4	3.1	3.7	3.0
22.0	2.5	2.5	2.7	2.8	3.2	3.2
22.5	3.6	3.5	3.6	3.8	4.0	4.0
25.5	3.4	3.0	3.5	3.7	4.2	4.5
27.5	4.2	4.2	4.5	4.2	5.0	5.1
31.0	4.1	4.1	4.2	4.6	5.2	4.8

slit formulae, (2) the absence of juvenile (i.e., specimens smaller than 5 mm long) forms in the collections, and (3) the questionable differential diagnosis from species of *Acanthochitona* (*A. elongata, A. interfissa, A. andersoni,* and two "*A. balesae*") with elongate body and convex-topped granules.

In *C. lata* [and likely in other elongate *Acanthochitona* species] the body elongation, i.e., narrowness, is accentuated by drying: body width/length ratio of dry specimens (mean = 0.32; SD = 0.076; N = 11); of alcohol-preserved ones (mean = 0.51; SD = 0.063; N = 25) ($P < 0.001$). In addition, the body elongation of *C. lata* is greater in large specimens than in small ones; the longer the specimen, the relatively narrower it is ($r = -0.62$; $P < 0.001$) (Fig. 18). Clearly, such variations in elongation are a source of potential confusion in identification, particularly when dry specimens are contrasted against live or alcohol-preserved ones.

Further, examination of several "growth series" of *C. lata* disclosed that, with growth, specimens of *C. lata* not only become more elongated (in selected specimens, width/length of the tegmental surface of valve iv "changed" from 1.6 to 0.7), but undergo significant allometric transformations leading to (1) accentuation and "moving-back" of mucro, (2) forward recurving of postmucro, (3) thickening of posterior edge of valve viii, and (4) progressive obliteration of insertion slits. Slit changes in *C. lata* had been anticipated by several workers: Pilsbry (1893e: 60) described a specimen, 25 mm long, with only 3 slits in the anterior valve, none in the others; Bergenhayn (1931: 2) cited a specimen with 4 slits in the anterior valve, a single slit in valve ii, none in the others; Kaas (1972: 57–58), described the slit formula of *C. lata* as 5–1–0, suggesting the slits may be reduced and disappear in the adult; and Van Belle (1983) gave the slit formula of *C. lata* as 3/5–0/1–0/2.

Comparison of small and large specimens of *C. lata* revealed, also, some other body changes: Large specimens tend to have (1) misshapen valves, particularly anterior (i–iv) ones, (2) anterior (ii–iv) valves much narrower than posterior (v–vii) ones (Table 2), the valve vi or vii being the widest, (3) tegmental erosion, much more common in anterior (i–iv) than in posterior (v–viii) valves, and (4) encrustations, much more common in posterior (vi–viii) valves than in anterior (i–iii) ones (Table 3). Small specimens, aside from being relatively wider, have (1) regularly shaped valves, and (2) pristine tegmental sculpture with no trace of erosion or encrustations. Since large specimens of *C. lata* are often reported collected in holes on dead coral (Smith, 1960; Warmke and Abbott, 1961; Kaas, 1972; R. G. Bromley, in litt., 27 Feb. 1980) while small specimens are not, it

Table 3. Encrusted (at least 50%) valves (*) in 18 specimens of *Choneplax lata* from same locality (CAS 014949: Exchange Bay, Antigua): Larger specimens (=>22 mm long) have more encrusted valves than smaller (<22 mm long) ones ($\chi^2 = 2.95$, $P < 0.05$, one-tailed). Posterior valves (v–viii) are more often encrusted than anterior (i–iv) ones ($\chi^2 = 19.24$, $P < 0.001$, two-tailed)

Specimen length (mm)	Valves encrusted (*)								Total
	i	ii	iii	iv	v	vi	vii	viii	
16							*		1
16				*					1
16					*	*	*	*	4
20									0
20							*		1
20	*					*	*		3
20					*	*	*	*	4
21									0
22									0
22									0
22					*	*			2
22				*		*		*	3
23							*		1
25								*	1
25						*	*	*	3
27					*	*		*	3
28	*				*	*	*	*	5
32	*		*	*			*	*	5
Total	3	0	1	3	5	9	9	7	
%	16	0	6	16	28	50	50	39	

seems likely that the morphological changes are related to a change in life style from perambulating juveniles to sedentary adults, to coral-borers, wedged head-first in holes, resulting in greater erosion and narrowing of anterior valves, and heavier encrustation of posterior (exposed) ones. Dr. Barry Roth (pers. comm., in litt., 15 July 1983), pointed out further that "perhaps the change is not from wandering juveniles to sedentary adults, but from ambulatory males to sedentary females (i.e., protandrous hermaphroditism)." The hypothesis is of considerable theoretical interest, and deserves testing in the field.

Acanthochiton balesae Pilsbry, 1940, fig. 5, is a nomen nudum. Abbott (1954) gave a brief account of "*Acanthochitona balesae* Pilsbry," which he later (1974) regarded as a synonym of *A. elongata.* Still, Watters (1981) reiterated its usage, referring to "*Acanthochitona balesae* Abbott, 1954" in the differential diagnosis of *A. andersoni.*

Acanthochitona elongata Kaas, 1972, based on four dry specimens with convex-topped granules, collected at Bonefish Key by A. Koto, displays all the features here attributed to juveniles of *C. lata,* as determined through the examination of 9 topotypes (LACM HH-1084, *leg.* A. Koto; LACM H-3532), and Kaas' (op. cit.) account and illustrations of the species.

Acanthochitona interfissa Kaas, 1972, was said to have the appearance of *A. elongata,* except for the smooth jugum, the posterior valve's profile, and a "well developed additional central slit" [a specimen from Aruba proved to have not one, but two additional slits "close together" (Kaas, 1972: 55)]. Again, the described features seem insufficient to distinguish it from the young of *C. lata.* A specimen 7.8 mm long, from Venezuela (LACM-AHF A20-39), here referred to *C. lata,* also shows a distinct nick between the two normal slits of the posterior valve.

Acanthochitona andersoni Watters, 1981, was said to have smooth jugum, and convex, "D-shaped" granules. It was distinguished from "*Acanthochitona balesae* Abbott, 1954," [regarded by Watters (op. cit.) as a senior synonym of *A. elongata* and *A. interfissa*] for its "bimorphic" girdle spicules. Examination of the holotype (ANSP 332171), and 4 paratypes (ANSP 220834; ANSP 325808; ANSP 325864) of *A. andersoni* revealed the granules to be mostly round to oval [not particularly "D-shaped"], somewhat variable in size, largest 100–120 μm in diameter, 30–40 μm apart [hardly "widely spaced"], and in one of the paratypes (ANSP 220834) aligned in rows parallel to the jugum [contradicting the statement that in "*A. andersoni* (the granules) tend to radiate from the beak; in *A. balesae* they are parallel to the jugum" (Watters, 1981: 176)]. A fragment of the girdle of the holotype [examined with the kind permission of ANSP] showed spicules, about 35 × 10 μm, crowded together, cigar-shaped, translucent, rather smooth, uniform in size and shape, providing no clue as to why they were called "bimorphic" by Watters (op. cit.).

Thus, *A. elongata* [with *A. interfissa* and *A. andersoni* as synonyms] appears to correspond to what is here interpreted as the small (young) form of *C. lata.* However, a few questions remain: In some small specimens of *C. lata* the sutural tufts have abundant, white (instead of few, and yellow-brown) spicules, and in some others the tegmental granules are aligned in rows parallel to the jugum (instead of in quincunx). These two departing features are not necessarily associated in the same specimen, nor related to locality, but they do cast some question upon the identification of the Barbados material. Accordingly, at least until large specimens of "typical" *C. lata* are found at the island, the determination of the 12 small specimens from Barbados is left tentative.

Since juveniles of *C. lata* may also be confused with specimens of the sympatric *Acanthochitona spiculosa* and *A. astrigera,* possible differential points should be considered: (1) The elongated body of *C. lata* is only characteristic of relatively large specimens; small specimens may have the same body width/length as specimens of *A. spiculosa* or *A. astrigera.* (2) The color of *C. lata* is usually greenish, particularly in the girdle, but the same color may be seen in specimens of *A. spiculosa* and *A. astrigera*; small specimens of *C. lata,* such as those cited here from Barbados, are often cream mottled with orange, or bright red, some with the zebra-like color pattern of concentric brown-cream banding also seen in *A. spiculosa* and *A. astrigera.* (3) The posterior edge of intermediate valves is angled in small specimens of *C. lata,* straight to biconcave in *A. spiculosa* and *A. astrigera.* (4) The girdle cigar- and club-shaped elements of *C. lata* are quite distinct from the pointed, spiculoid elements of *A. spiculosa* and *A. astrigera.* (5) In the girdle tufts, the spicules are usually few, short, thick (up to 30 μm), blunt, yellowish brown in *C. lata,* but abundant, long, thin (up to 20 μm), white in *A. spiculosa* and *A. astrigera.* However, in occasional specimens of *C. lata,* these spicules are white in some or all of the tufts, resembling those of *A. spiculosa* and *A. astrigera.* (6) The tegmental granules (pustules) are convex-topped in *C. lata,* flat- to concave-topped in *A. spiculosa* and *A. astrigera.* Unfortunately, on account of erosion, the distinction may not always be apparent. (7) The radula and gills are identical in *C. lata, A. spiculosa,* and *A. astrigera.*

The differences between *Choneplax lata* and species of *Acanthochitona,* particularly when small specimens are considered, seem inadequate to justify separation at the generic level. However, a decision on the matter is beyond the scope of this paper, and must await a full review of the group. Meanwhile, it must be accepted as evident that, as previously proposed (Bergenhayn, 1955; Smith, 1960; Van Belle 1983), *Choneplax* and *Acanthochitona* are close enough to be allocated to the same taxon, Acanthochitonidae.

Discussion

Acanthochitona spiculosa (Reeve, 1847) was reported from Barbados (Dall, 1889a; Pilsbry, 1893e) probably in error. Although it ranges [with *A. pygmaea* (Pilsbry, 1893c) here regarded as synonym] from Bermuda (32°22'N) (Crozier, 1920; Peile, 1926; AJF 339) to São Paulo, Brazil (23°33'S) (Righi, 1971), and from Gulfport, Florida (82°43'W) (LACM A.2777; LACM HH-1082) to Fernando de Noronha, Brazil (32°25'W) (Smith, 1890), at depths of 0–8 m—its presence in Barbados has not been corroborated (Lewis, 1960; Conde, 1966; Ferreira, herein).

Several other recognized Caribbean chiton species have not been found in collections from Barbados: *Leptochiton pergranatus* (Dall, 1889), *Leptochiton binghami* (Boone, 1928), *Hanleya tropicalis* (Dall, 1881), *Stenosemus exaratus* (Sars, 1878), *Chaetopleura apiculata* (Say, 1830), *Calloplax janeirensis* (Gray, 1828), *Ischnochiton hartmeyeri* Thiele, 1910, *Ischnochiton dilatosculptus* Kaas, 1982, *Callistochiton shuttleworthianus* Pilsbry, 1893c, *Callistochiton portobelensis* Ferreira, 1976, *Chiton squamosus* Linnaeus, 1764, *Acanthochitona bonairensis* Kaas, 1972, and *Cryptoconchus floridanus* (Dall, 1889b).

Of the 17 chiton species here recognized in Barbados: (1) one, *Ischnochiton bromleyi,* is possibly endemic, (2) four, *Ischnochiton striolatus, Stenoplax limaciformis, S. boogii,* and *Ischnoplax pectinata,* range southward to Brazil, and (3) five, *Lepidochitona beanii, Ceratozona squalida, Acanthochitona rhodea, Stenoplax limaciformis* and *S. boogii,* are also present in the tropical eastern Pacific.

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